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Takatsuki

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(54) **IMAGE READING APPARATUS, IMAGE PROCESSING METHOD**

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H04N 1/04 (2006.01)
H04N 1/00 (2006.01)
H04N 1/23 (2006.01)

(52) **U.S. Cl.**
CPC ***H04N 1/0057*** (2013.01); ***H04N 1/2346*** (2013.01)

(58) **Field of Classification Search**
CPC H04N 1/0057; H04N 1/2346
See application file for complete search history.

(56) **References Cited**

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(57) **ABSTRACT**

A first image reading portion is disposed in a body portion. A conveying device is disposed in a cover portion. A second image reading portion is disposed in the cover portion. An inclination derivation portion derives two inclination angles of a document sheet respectively corresponding to the first image reading portion and the second image reading portion by performing image processing on two read images obtained by the first image reading portion and the second image reading portion. An information output portion outputs inclination correction information based on the difference between the two inclination angles through an information output device.

5 Claims, 5 Drawing Sheets

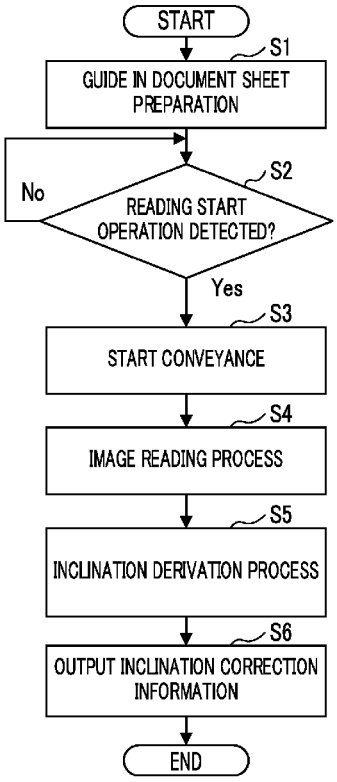

FIG. 1

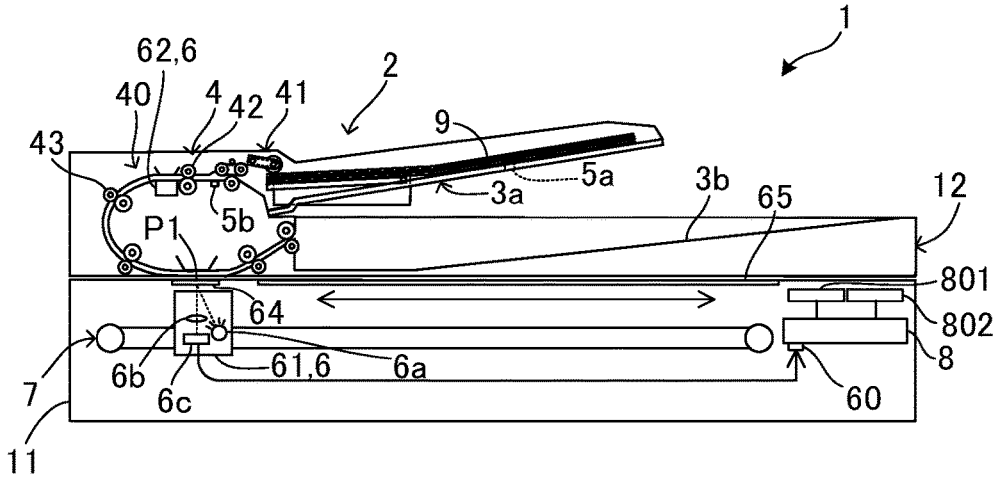
1
62,6
2
40
4
42
41
9
43
5a
3a
3b
65
12
P1
5b
801
64
802
8
7
6b
61,6
6a
6c
60
11

FIG. 2

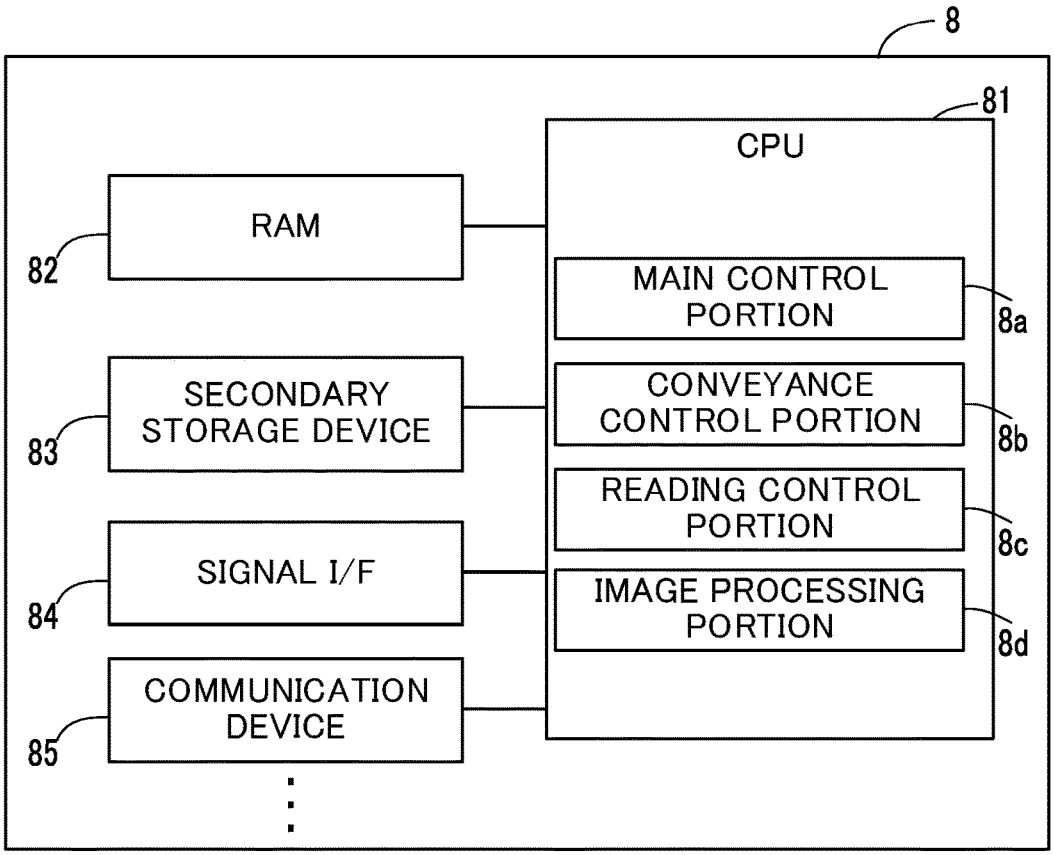
8
81
CPU
RAM
82
MAIN CONTROL PORTION
8a
SECONDARY STORAGE DEVICE
83
CONVEYANCE CONTROL PORTION
8b
READING CONTROL PORTION
8c
SIGNAL I/F
84
IMAGE PROCESSING PORTION
8d
COMMUNICATION DEVICE
85

FIG. 3

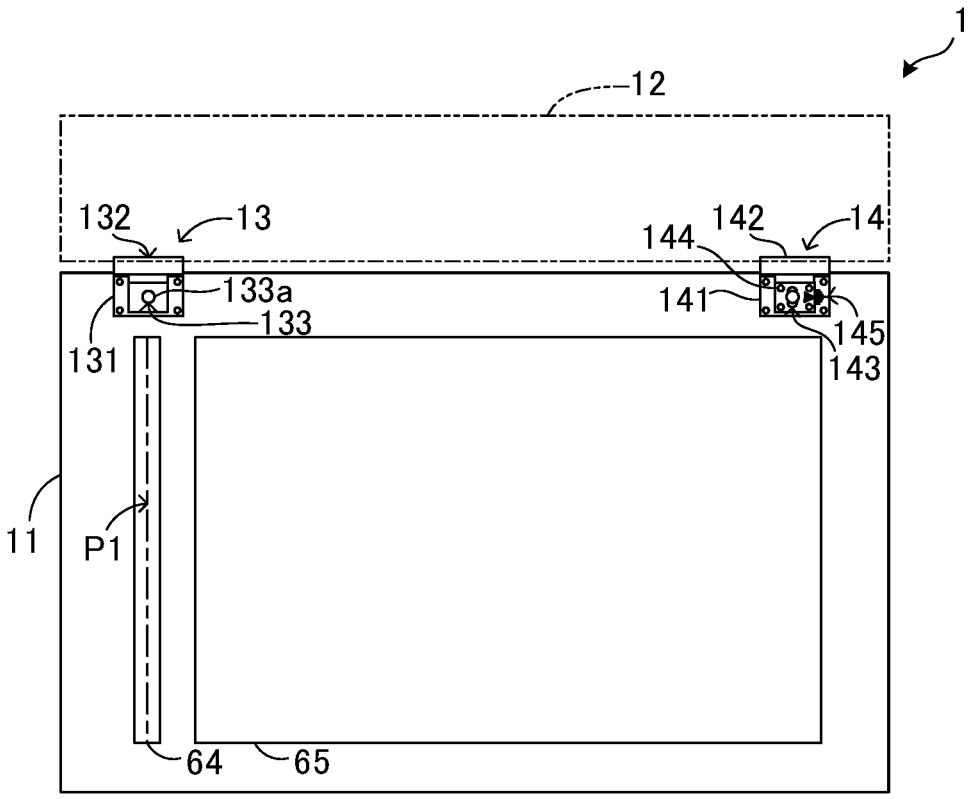

FIG. 4

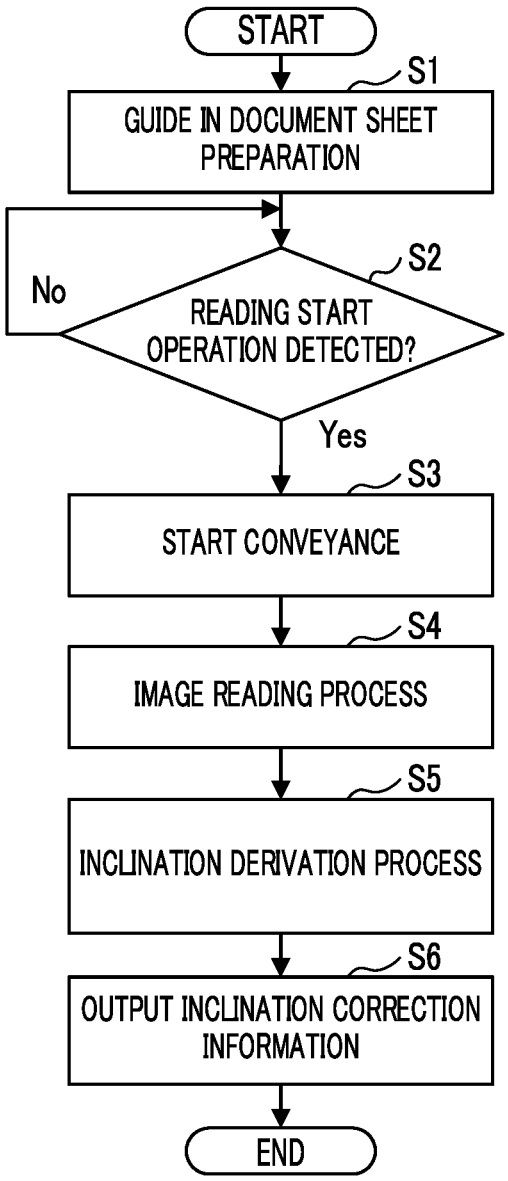
START
S1
GUIDE IN DOCUMENT SHEET PREPARATION
S2
No
READING START OPERATION DETECTED?
Yes
S3
START CONVEYANCE
S4
IMAGE READING PROCESS
S5
INCLINATION DERIVATION PROCESS
S6
OUTPUT INCLINATION CORRECTION INFORMATION
END

FIG. 5

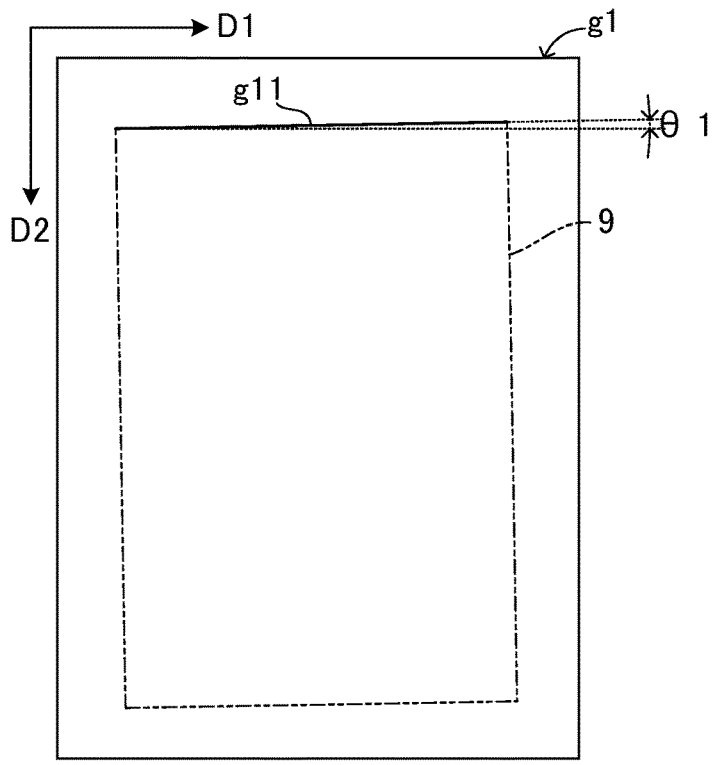

FIG. 6

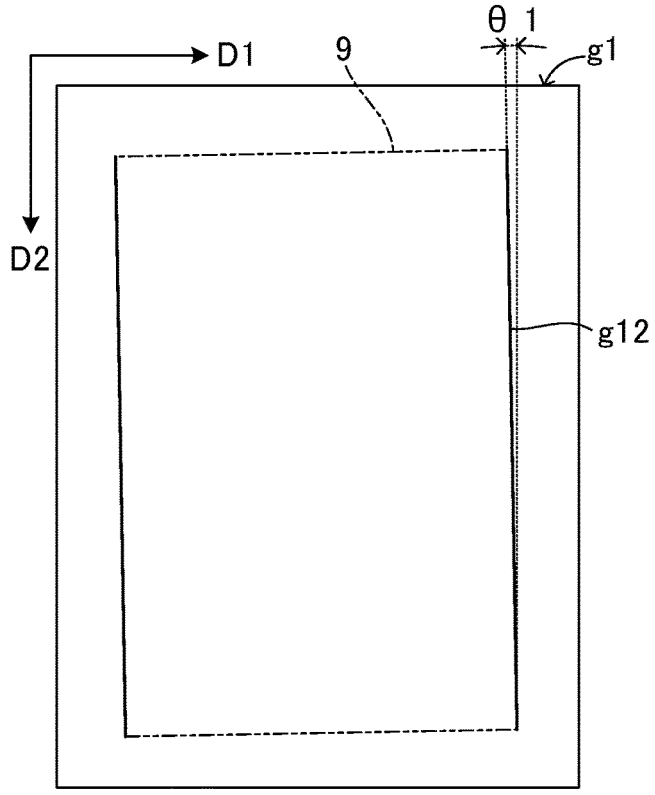

FIG. 7

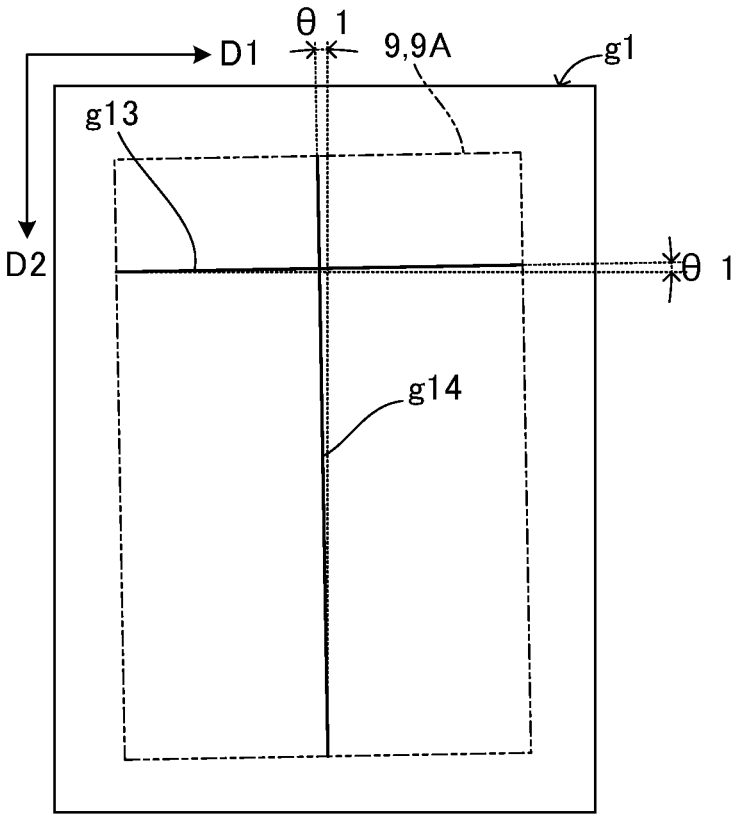

IMAGE READING APPARATUS, IMAGE PROCESSING METHOD

INCORPORATION BY REFERENCE

This application is based upon and claims the benefit of priority from the corresponding Japanese Patent Application No. 2021-044028 filed on Mar. 17, 2021, the entire contents of which are incorporated herein by reference.

BACKGROUND

The present disclosure relates to an image reading apparatus and an image processing method facilitating adjustment of inclination of a cover portion relative to a body portion.

An image reading apparatus often includes a document sheet conveying device and an image reading portion that reads images from document sheets conveyed by the document sheet conveying device. Typically, the image reading portion is disposed inside a body portion. In addition, the document sheet conveying device is integrated into a cover portion that can open and close the upper surface of the body portion.

The cover portion may be inclined with respect to its original orientation when attached to the body portion. In this case, read images obtained by the image reading portion inside the body portion are deformed compared with the original images.

Accordingly, it is important to attach the cover portion to the body portion in its original orientation.

For example, it is known that the image reading portion in the body portion performs an image reading process on a part with a specific mark on the cover portion to cause a recognition portion to recognize the difference between the position of the mark detected from the read images and a target position.

SUMMARY

An image reading apparatus according to an aspect of the present disclosure includes a body portion, a first image reading portion, a cover portion, a conveying device, a second image reading portion, an inclination derivation portion, and an information output portion. The first image reading portion is disposed in the body portion and configured to read an image from a document sheet while the document sheet passes through a reading position on an upper surface of the body portion. The cover portion is connected to the body portion and supported to be able to open and close the upper surface of the body. The conveying device is disposed in the cover portion and configured to convey the document sheet along a conveyance path extending via the reading position. The second image reading portion is disposed in the cover portion and configured to read an image from the document sheet while the document sheet is conveyed along the conveyance path. The inclination derivation portion is configured to execute an inclination derivation process of deriving two inclination angles of the document sheet respectively corresponding to the first image reading portion and the second image reading portion by performing image processing on two read images obtained by the first image reading portion and the second image reading portion. The information output portion is configured to output inclination correction information based on a difference between the two inclination angles through an information output device.

An image processing method according to another aspect of the present disclosure is a method of processing read images obtained by an image reading apparatus including the body portion, the first image reading portion, the cover portion, the conveying device, and the second image reading portion. The image processing method includes executing an inclination derivation process of deriving two inclination angles of the document sheet respectively corresponding to the first image reading portion and the second image reading portion by performing image processing on two read images obtained by the first image reading portion and the second image reading portion. The image processing method further includes outputting inclination correction information based on a difference between the two inclination angles through an information output device.

This Summary is provided to introduce a selection of concepts in a simplified form that are further described below in the Detailed Description with reference where appropriate to the accompanying drawings. This Summary is not intended to identify key features or essential features of the claimed subject matter, nor is it intended to be used to limit the scope of the claimed subject matter. Furthermore, the claimed subject matter is not limited to implementations that solve any or all disadvantages noted in any part of this disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a configuration diagram of an image reading apparatus according to an embodiment.

FIG. **2** is a block diagram showing a configuration of a control device in the image reading apparatus according to the embodiment.

FIG. **3** is a configuration diagram of a cover connecting mechanism in the image reading apparatus according to the embodiment.

FIG. **4** is a flowchart showing an example of a procedure of an adjustment assistance process in the image reading apparatus according to the embodiment.

FIG. **5** shows an example of an upper edge portion of a document sheet detected from a read image.

FIG. **6** shows an example of a side edge portion of a document sheet detected from a read image.

FIG. **7** shows an example of line images on a calibration document sheet detected from a read image.

DETAILED DESCRIPTION

The following describes an embodiment of the present disclosure with reference to the accompanying drawings. It should be noted that the following embodiment is an example of a specific embodiment of the present disclosure and should not limit the technical scope of the present disclosure.

[Configuration of Image Reading Apparatus **1**]

An image reading apparatus **1** according to an embodiment is capable of conveying document sheets **9** and reading images on the conveyed document sheets **9**.

As shown in FIG. **1**, the image reading apparatus **1** includes a body portion **11** and a cover portion **12** that covers the upper surface of the body portion **11**. The body portion **11** is a housing that houses various types of components.

The cover portion **12** is connected to the body portion **11** and supported to be displaceable between a closed position at which the cover portion **12** covers the upper surface of the body portion **11** and an open position at which the cover portion **12** opens the upper surface of the body portion **11**.

That is, the cover portion **12** is supported to be able to open and close the upper surface of the body portion **11**.

The image reading apparatus **1** further includes a contact glass **64** and a platen glass **65** disposed on the upper surface of the body portion **11**. The contact glass **64** and the platen glass **65** are transparent plate-like members.

The image reading apparatus **1** further includes a document sheet conveying device **2**, an image reading portion **6**, a moving mechanism **7**, a control device **8**, an operation device **801**, and a display device **802**. The document sheet conveying device **2** is integrated into the cover portion **12**.

The document sheet conveying device **2** includes a supply tray **3***a*, a discharge tray **3***b*, a conveyance path **40**, a conveying device **4**, a supplied document sheet sensor **5***a*, and a conveyed document sheet sensor **5***b*. The supply tray **3***a* and the discharge tray **3***b* can hold the document sheets **9**.

The conveyance path **40** forms a path along which the document sheets **9** are conveyed inside the cover portion **12**. The conveyance path **40** extends from an entrance corresponding to the supply tray **3***a* to an exit corresponding to the discharge tray **3***b* via a reading position P**1** on the contact glass **64**.

The supplied document sheet sensor **5***a* detects the document sheets **9** placed on the supply tray **3***a*. For example, the supplied document sheet sensor **5***a* includes a first displaceable member and a first detection sensor (both not shown).

The first displaceable member is displaced to a lower position below an upper position serving as an initial position upon receiving the load of the document sheets **9** on the supply tray **3***a*. The first detection sensor detects the first displaceable member displaced to the lower position.

The conveyed document sheet sensor **5***b* detects the document sheets **9** fed from the supply tray **3***a* to the conveyance path **40**. For example, the conveyed document sheet sensor **5***b* includes a second displaceable member and a second detection sensor (both not shown).

The second displaceable member is displaced from a reference position to a retracted position by coming into contact with the document sheets **9** fed from the supply tray **3***a* to the conveyance path **40**. The second detection sensor detects the second displaceable member displaced to the retracted position.

The conveying device **4** is disposed inside the cover portion **12**. The conveying device **4** feeds the document sheets **9** on the supply tray **3***a* one by one to the conveyance path **40**, conveys the document sheets **9** along the conveyance path **40**, and then discharges the document sheets **9** onto the discharge tray **3***b*.

The conveying device **4** includes a feed mechanism **41** corresponding to the supply tray **3***a* and pairs of conveying rollers **43** disposed along the conveyance path **40**.

The feed mechanism **41** feeds the document sheets **9** on the supply tray **3***a* one by one to the conveyance path **40**. In the present embodiment, the feed mechanism **41** feeds the topmost sheet in the document sheets **9** on the supply tray **3***a* to the conveyance path **40**.

The pairs of conveying rollers **43** are rotationally driven by motors (not shown). This causes the pairs of conveying rollers **43** to convey the document sheets **9** along the conveyance path **40** and to discharge the document sheets **9** from the conveyance path **40** to the discharge tray **3***b*.

The image reading portion **6** executes an image reading process of reading images formed on the document sheets **9** and outputting data about the read images. The image reading portion **6** can execute the image reading process on the document sheets **9** conveyed along the conveyance path **40**. The image reading portion **6** can also execute the image reading process on the document sheets **9** placed on the platen glass **65**. In the description below, the images read from the document sheets **9** by the image reading portion **6** are referred to as "read images g**1**" (see FIGS. **5** to **7**).

In the present embodiment, the image reading portion **6** includes a first image reading portion **61**, a second image reading portion **62**, and an AFE (Analog Front End) **60**.

In the description below, the upper surfaces of the document sheets **9** placed on the supply tray **3***a* are referred to as "first sides", and the lower surfaces of the document sheets **9** placed on the supply tray **3***a* are referred to as "second sides".

The first image reading portion **61** is disposed inside the body portion **11**. The first image reading portion **61** reads images on the first sides of the document sheets **9** passing through the reading position P**1** on the conveyance path **40** while being kept at a position facing the reading position P**1**.

The second image reading portion **62** is disposed inside the cover portion **12**. The second image reading portion **62** reads images on the second sides of the document sheets **9** conveyed along the conveyance path **40**. The second image reading portion **62** reads the images on the document sheets **9** at a position on the conveyance path **40** upstream of the reading position P**1** in a conveying direction along which the document sheets **9** are conveyed.

In the present embodiment, the first image reading portion **61** and the second image reading portion **62** each include a light-emitting portion **6***a*, a lens **6***b*, and an image sensor **6***c* (see FIG. **1**). The light-emitting portions **6***a*, the lenses **6***b*, and the image sensors **6***c* extend in a main scanning direction.

The light-emitting portions **6***a* emit light beams onto the document sheets **9**. The lenses **6***b* guide the light beams reflected from the document sheets **9** to the respective image sensors **6***c*. The image sensors **6***c* are line sensors that determine the intensity of the light beams reflected from the document sheets **9** and that output detection signals as signals of the read images g**1**.

The AFE **60** converts the signals of the read images g**1** into digital image data and outputs the image data. The digital image data corresponds to data about the read images g**1**.

In the example shown in FIG. **1**, the first image reading portion **61** and the second image reading portion **62** are CISs (Contact Image Sensors) each including the light-emitting portion **6***a*, the lens **6***b*, and the image sensor **6***c* of the CMOS (Complementary Metal Oxide Semiconductor) type integrated together.

The moving mechanism **7** moves the first image reading portion **61** in a range from the position facing the contact glass **64** to a position facing the platen glass **65**.

In a case where the document sheets **9** are conveyed by the conveying device **4**, the moving mechanism **7** keeps the first image reading portion **61** at the position facing the contact glass **64**.

In a case where the document sheets **9** are placed on the platen glass **65**, the moving mechanism **7** moves the first image reading portion **61** along the platen glass **65**. Thus, the image sensor **6***c* of the first image reading portion **61** reads the images on the document sheets **9** while the light-emitting portion **6***a* of the first image reading portion **61** scans the light beam over the document sheets **9** on the platen glass **65**.

That is, when the conveying device **4** operates, the image reading portion **6** executes the image reading process on the document sheets **9** conveyed along the conveyance path **40**. In contrast, when the conveying device **4** does not operate,

the image reading portion **6** executes the image reading process on the document sheets **9** placed on the platen glass **65**.

It is noted that the image sensor **6***c* of the first image reading portion **61** may be a CCD (Charge Coupled Device) sensor. In this case, the moving mechanism **7** moves the light-emitting portion **6***a* and the lens **6***b* while the image sensor **6***c* of the CCD type is fixed at a predetermined position.

The operation device **801** is configured to receive operations from users and includes, for example, operation buttons and a touch panel. The display device **802** is configured to display information and includes, for example, a panel display device such as a liquid crystal display unit.

The control device **8** executes various types of data processing and controls the image reading apparatus **1**. As shown in FIG. **2**, the control device **8** includes a CPU (Central Processing Unit) **81**, a RAM (Random Access Memory) **82**, a secondary storage device **83**, and peripherals such as a signal interface **84**. The control device **8** further includes a communication device **85** that communicates with other devices.

The secondary storage device **83** is a computer-readable nonvolatile storage device. The secondary storage device **83** can store and update computer programs and various types of data. For example, either a flash memory or a hard disk drive, or both, may be adopted as the secondary storage device **83**.

The signal interface **84** converts signals output by various types of sensors into digital data and transmits the converted digital data to the CPU **81**. Furthermore, the signal interface **84** converts control commands output by the CPU **81** into control signals and transmits the control signals to components to be controlled.

The CPU **81** is a processor that executes the computer programs to execute various types of data processing and control. The RAM **82** is a computer-readable volatile storage device. The RAM **82** primarily stores the computer programs executed by the CPU **81** and data that is output or consulted by the CPU **81** during execution of various types of processing.

The CPU **81** includes a plurality of processing modules that are implemented when the computer programs are executed. The plurality of processing modules include a main control portion **8***a*, a conveyance control portion **8***b*, a reading control portion **8***c*, and an image processing portion **8***d*.

The main control portion **8***a* executes control that causes various types of processing to be started in response to operations on the operation device **801** and executes control of the display device **802**. The conveyance control portion **8***b* controls the conveying device **4** to control the conveyance of the document sheets **9**.

The reading control portion **8***c* controls the image reading portion **6** to cause the image reading portion **6** to execute the image reading process. The image processing portion **8***d* executes various types of image processing on the read images g**1** obtained by the image reading process.

The cover portion **12** may be inclined with respect to its original orientation when attached to the body portion **11**. In this case, the read images g**1** obtained by the first image reading portion **61** inside the body portion **11** are deformed compared with the original images.

Accordingly, it is important to attach the cover portion **12** to the body portion **11** in its original orientation.

As shown in FIG. **3**, the cover portion **12** is connected to the body portion **11** by a cover connecting mechanism **13**, **14** to be pivotable vertically. The cover connecting mechanism **13**, **14** includes a first connecting portion **13** and a second connecting portion **14**.

The first connecting portion **13** includes a first base member **131** secured to the body portion **11** and a first hinge member **132** connected to the first base member **131**. For example, the first base member **131** is secured to the body portion **11** with screws.

One of a pair of plate portions that constitute the first hinge member **132** is connected to the first base member **131**, and the other is connected to the cover portion **12**. For example, the first hinge member **132** is connected to the cover portion **12** with screws.

The first connecting portion **13** further includes a rotatable connection mechanism **133**. The rotatable connection mechanism **133** connects the first hinge member **132** to the first base member **131** such that the first hinge member **132** is rotatable along the upper surface of the body portion **11**. The first hinge member **132** is rotatable around a connecting shaft **133***a* relative to the first base member **131**.

Accordingly, the first connecting portion **13** connects the cover portion **12** to the body portion **11** such that the cover portion **12** is pivotable vertically and rotatable around the connecting shaft **133***a* along the upper surface of the body portion **11**.

For example, the connecting shaft **133***a* is disposed on the extension of the reading position P**1** extending in the longitudinal direction of the contact glass **64**.

The second connecting portion **14** includes a second base member **141** secured to the body portion **11** and a second hinge member **142** connected to the second base member **141**. For example, the second base member **141** is secured to the body portion **11** with screws.

One of a pair of plate portions that constitute the second hinge member **142** is connected to the second base member **141**, and the other is connected to the cover portion **12**. For example, the second hinge member **142** is connected to the cover portion **12** with screws.

The second connecting portion **14** further includes a movable connection mechanism **143**. The movable connection mechanism **143** connects the second hinge member **142** to the second base member **141** such that the second hinge member **142** is displaceable along an arc.

The second hinge member **142** is displaceable along the arc centered on the connecting shaft **133***a*. The second hinge member **142** is secured to the second base member **141** with fasteners **144** such as screws.

The angle of the cover portion **12** relative to the body portion **11** is adjusted by loosening the fasteners **144** and adjusting the position of the second hinge member **142** relative to the second base member **141**. The angle of the cover portion **12** to be adjusted is an angle about the connecting shaft **133***a* serving as the center of rotation.

In the present embodiment, the rotatable connection mechanism **133** and the movable connection mechanism **143** are an example of an inclination adjustment mechanism in the cover connecting mechanism **13**, **14** that connects the cover portion **12** to the body portion **11**.

The second base member **141** has a plurality of graduation marks **145** that indicate the position of the second hinge member **142** relative to the second base member **141**. Each of the graduation marks **145** indicates an amount of adjustment in the inclination adjustment mechanism. The graduation marks **145** quantify the amounts of adjustment in the inclination adjustment mechanism.

In a case where an image of a mark made on a part of the cover portion **12** is read by the first image reading portion **61**

in the body portion **11**, the inclination of the cover portion **12** relative to the body portion **11** can be derived based on the difference between the position of the mark in the read image g**1** and a target position.

However, in a case where a calibration member such as a plate with the mark is not attached to the cover portion **12** at a correct position and in a correct orientation, the inclination of the cover portion **12** cannot be derived correctly.

In addition, it is difficult to determine whether the calibration member is attached to the cover portion **12** at the correct position and in the correct orientation.

In the image reading apparatus **1**, the CPU **81** executes an adjustment assistance process (described below; see FIG. **4**). The adjustment assistance process is a process for facilitating the adjustment of inclination of the cover portion **12** relative to the body portion **11** in the case where the cover portion **12** is attached to the body portion **11**.

The main control portion **8***a* starts the adjustment assistance process upon detecting a predetermined adjustment start operation on the operation device **801**.

[Adjustment Assistance Process]

The following describes an example of a procedure of the adjustment assistance process with reference to a flowchart shown in FIG. **4**. The adjustment assistance process is an embodiment of an image processing method of processing the read images g**1** obtained by the image reading apparatus **1**.

In the following description, S1, S2, . . . are identification signs representing a plurality of steps in the adjustment assistance process. In the adjustment assistance process, a process in step S1 is executed first.

<Step S1>

In step S1, the main control portion **8***a* executes a document sheet preparation guide process of causing the display device **802** to display predetermined guide information. Subsequently, the main control portion **8***a* moves the process to step S2.

The guide information provides guidance on placing a predetermined document sheet **9** on the supply tray **3***a*. For example, the guide information provides guidance on placing a document sheet **9** of a predetermined size on the supply tray **3***a*.

In addition, the guide information may provide guidance on placing a predetermined calibration document sheet **9**A on the supply tray **3***a* (see FIG. **7**). The calibration document sheet **9**A is a document sheet **9** having predetermined line images formed on both sides.

For example, the calibration document sheet **9**A has either a horizontal line image g**13** extending in the horizontal direction of the calibration document sheet **9**A or a vertical line image g**14** extending in the vertical direction of the calibration document sheet **9**A on each side.

<Step S2>

In step S2, the main control portion **8***a* moves the process to step S3 upon detecting a reading start operation on the operation device **801** while the document sheet **9** on the supply tray **3***a* is detected by the supplied document sheet sensor **5***a*.

The main control portion **8***a* waits until the main control portion **8***a* detects the reading start operation while the document sheet **9** on the supply tray **3***a* is detected by the supplied document sheet sensor **5***a*.

<Step S3>

In step S3, the conveyance control portion **8***b* causes the conveying device **4** to start conveying the document sheet **9** and then moves the process to step S4.

<Step S4>

In step S4, the reading control portion **8***c* causes the image reading portion **6** to execute the image reading process. Subsequently, the reading control portion **8***c* moves the process to step S5.

The process in step S4 causes the second image reading portion **62** to execute the image reading process on the second side of the document sheet **9** and causes the first image reading portion **61** to execute the image reading process on the first side of the document sheet **9**. This results in two read images g**1** corresponding to both sides of the document sheet **9**.

<Step S5>

In step S5, the image processing portion **8***d* executes an inclination derivation process. Subsequently, the image processing portion **8***d* moves the process to step S6. The image processing portion **8***d* that executes the process in step S5 is an example of an inclination derivation portion.

The inclination derivation process is a process of deriving two inclination angles **81** of the document sheet respectively corresponding to the first image reading portion **61** and the second image reading portion **62** by performing image processing on the two read images g**1** obtained in step S4 (see FIGS. **5** and **6**).

For example, in step S5, the image processing portion **8***d* detects an edge portion such as an upper edge portion g**11** or a side edge portion g**12** of the rectangular document sheet **9** from the read images g**1** (see FIGS. **5** and **6**).

Specifically, the image processing portion **8***d* executes a known edge detection process on the read images g**1** in a vertical direction D**2** to detect the upper edge portion g**11** of the document sheet **9**. In addition, the image processing portion **8***d* executes the edge detection process on the read images g**1** in a horizontal direction D**1** to detect the side edge portion g**12** of the document sheet **9**.

Furthermore, the image processing portion **8***d* derives the tilt angles of the edge portion relative to a predetermined reference direction as the inclination angles **81** of the document sheet (see FIGS. **5** and **6**).

In addition, in a case where the read images g**1** are those read from the calibration document sheet **9**A, the image processing portion **8***d* can detect the horizontal line images g**13** or the vertical line images g**14** by the edge detection process.

In addition, in a case where the horizontal line images g**13** or the vertical line images g**14** are images of a predetermined chromatic color such as red, green, or blue, the image processing portion **8***d* can detect the horizontal line images g**13** or the vertical line images g**14** by detecting images of a specific color from the read images g**1** (see FIG. **7**).

In addition, the image processing portion **8***d* can derive the tilt angles of the horizontal line images g**13** or the vertical line images g**14** relative to the predetermined reference direction as the inclination angles **81** of the document sheet (see FIG. **7**).

Usually, the orientation of the document sheet **9** does not substantially change while the document sheet **9** is conveyed from the position of the second image reading portion **62** to the reading position P**1**.

Accordingly, the difference between the two inclination angles **81** derived in step S5 represents the angle formed between the longitudinal direction of the first image reading portion **61** and the longitudinal direction of the second image reading portion **62**. In addition, the angle formed between the longitudinal direction of the first image reading portion **61** and the longitudinal direction of the second image reading portion **62** represents the inclination of the cover portion **12** relative to the body portion **11**.

For convenience, FIGS. **5** to **7** show examples of the inclination angles **81** that are not 0°. However, when the inclination of the cover portion **12** is adjusted, at least the inclination angle **81** corresponding to the read image g**1** obtained by the second image reading portion **62** is substantially 0° in most cases.

The image processing portion **8***d* may move the process to step S1 in a case where the inclination angle **81** derived from the read image g**1** obtained by the second image reading portion **62** is outside a predetermined allowable range. Thus, the processes in steps S1 to S4 are repeated until the document sheet **9** is conveyed in the correct orientation without slanting.

In addition, in a case where the processes in steps S1 to S4 are repeated a predetermined number of times, the main control portion **8***a* may cause the display device **802** to display in-cover adjustment information. The in-cover adjustment information prompts an adjuster to adjust the installation states of the document sheet conveying device **2** and the second image reading portion **62** in the cover portion **12**.

<Step S6>

In step S6, the main control portion **8***a* outputs inclination correction information based on the difference between the two inclination angles **81** derived in step S5 through the display device **802**. Subsequently, the main control portion **8***a* ends the adjustment assistance process.

The main control portion **8***a* that executes the process in step S6 is an example of an information output portion. In addition, the display device **802** is an example of an information output device. It is noted that the main control portion **8***a* may output the inclination correction information in the form of voice through a sound output device (not shown). The sound output device is another example of the information output device.

For example, the inclination correction information includes information about an amount of adjustment, indicated by the graduation marks **145**, in the movable connection mechanism **143** converted from the difference between the two inclination angles **81**. The amount of adjustment indicated by the graduation marks **145** is an example of an amount of adjustment in the inclination adjustment mechanism.

According to the present embodiment, the inclination of the cover portion **12** relative to the body portion **11** can be easily adjusted. In addition, the calibration member with the mark to be read by the first image reading portion **61** does not need to be attached to the cover portion **12**.

APPLICATION EXAMPLE

The processes in steps S5 and S6 in the adjustment assistance process shown in FIG. **4** may be executed by a processor of an information processing apparatus that can communicate with the image reading apparatus **1**. In this case, the CPU **81** transmits data about the two read images g**1** obtained in step S4 to the information processing apparatus through the communication device **85**.

The processor of the information processing apparatus receives the data about the two read images g**1** from the image reading apparatus **1** and executes the processes in steps S5 and S6. The present application example produces effects similar to those produced by the embodiment described above.

It is to be understood that the embodiments herein are illustrative and not restrictive, since the scope of the disclosure is defined by the appended claims rather than by the description preceding them, and all changes that fall within metes and bounds of the claims, or equivalence of such metes and bounds thereof are therefore intended to be embraced by the claims.

The invention claimed is:

1. An image reading apparatus comprising:

a body portion;

a first image reading portion disposed in the body portion and configured to read an image from a document sheet while the document sheet passes through a reading position on an upper surface of the body portion;

a cover portion connected to the body portion and supported to be able to open and close the upper surface of the body portion;

a conveying device disposed in the cover portion and configured to convey the document sheet along a conveyance path extending via the reading position;

a second image reading portion disposed in the cover portion and configured to read an image from the document sheet while the document sheet is conveyed along the conveyance path;

an inclination derivation portion configured to execute an inclination derivation process of deriving two inclination angles of the document sheet respectively corresponding to the first image reading portion and the second image reading portion by performing image processing on two read images obtained by the first image reading portion and the second image reading portion; and

an information output portion configured to output inclination correction information based on a difference between the two inclination angles through an information output device, wherein

the cover portion is connected to the body portion by a cover connecting mechanism, and

the inclination correction information includes information about an amount of adjustment to an inclination adjustment mechanism in the cover connecting mechanism converted from the difference between the two inclination angles.

2. The image reading apparatus according to claim **1**, wherein

the inclination derivation process includes:

detecting an edge portion of the document sheet having a rectangular shape from each of the read images; and

deriving tilt angles of the edge portion relative to a predetermined reference direction as the inclination angles of the document sheet.

3. An image reading apparatus comprising:

a body portion;

a first image reading portion disposed in the body portion and configured to read an image from a document sheet while the document sheet passes through a reading position on an upper surface of the body portion;

a cover portion connected to the body portion and supported to be able to open and close the upper surface of the body portion;

a conveying device disposed in the cover portion and configured to convey the document sheet along a conveyance path extending via the reading position;

a second image reading portion disposed in the cover portion and configured to read an image from the document sheet while the document sheet is conveyed along the conveyance path;

an inclination derivation portion configured to execute an inclination derivation process of deriving two inclina-

tion angles of the document sheet respectively corresponding to the first image reading portion and the second image reading portion by performing image processing on two read images obtained by the first image reading portion and the second image reading portion; and

an information output portion configured to output inclination correction information based on a difference between the two inclination angles through an information output device, wherein

the inclination derivation process includes:

detecting a line image set in advance and included in each of the read images; and

deriving tilt angles of the line images relative to a predetermined reference direction as the inclination angles of the document sheet.

4. An image processing method of processing read images obtained by an image reading apparatus,

the image reading apparatus comprising:

a body portion;

a first image reading portion disposed in the body portion and configured to read an image from a document sheet while the document sheet passes through a reading position on an upper surface of the body portion;

a cover portion connected to the body portion and supported to be able to open and close the upper surface of the body portion;

a conveying device disposed in the cover portion and configured to convey the document sheet along a conveyance path extending via the reading position; and

a second image reading portion disposed in the cover portion and configured to read an image from the document sheet while the document sheet is conveyed along the conveyance path,

the image processing method comprising:

executing an inclination derivation process of deriving two inclination angles of the document sheet respectively corresponding to the first image reading portion and the second image reading portion by performing image processing on two read images obtained by the first image reading portion and the second image reading portion; and

outputting inclination correction information based on a difference between the two inclination angles through an information output device, wherein

the cover portion is connected to the body portion by a cover connecting mechanism, and

the inclination correction information includes information about an amount of adjustment to an inclination adjustment mechanism in the cover connecting mechanism converted from the difference between the two inclination angles.

5. An image processing method of processing read images obtained by an image reading apparatus,

the image reading apparatus comprising:

a body portion;

a first image reading portion disposed in the body portion and configured to read an image from a document sheet while the document sheet passes through a reading position on an upper surface of the body portion;

a cover portion connected to the body portion and supported to be able to open and close the upper surface of the body portion;

a conveying device disposed in the cover portion and configured to convey the document sheet along a conveyance path extending via the reading position; and

a second image reading portion disposed in the cover portion and configured to read an image from the document sheet while the document sheet is conveyed along the conveyance path,

the image processing method comprising:

executing an inclination derivation process of deriving two inclination angles of the document sheet respectively corresponding to the first image reading portion and the second image reading portion by performing image processing on two read images obtained by the first image reading portion and the second image reading portion; and

outputting inclination correction information based on a difference between the two inclination angles through an information output device, wherein

the inclination derivation process includes:

detecting a line image set in advance and included in each of the read images; and

deriving tilt angles of the line images relative to a predetermined reference direction as the inclination angles of the document sheet.

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